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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference RSJ05825WO	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB99/03241	International filing date (day/month/year) 30/09/1999	Priority date (day/month/year) 01/10/1998
International Patent Classification (IPC) or national classification and IPC B23K26/00		
Applicant THE WELDING INSTITUTE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 04/04/2000	Date of completion of this report 20.11.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer De Backer, T Telephone No. +49 89 2399 7403 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/03241

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:

Description, pages:

3-11	as originally filed			
1,2	as received on	23/10/2000	with letter of	20/10/2000

Claims, No.:

2-21	as originally filed			
1	as received on	23/10/2000	with letter of	20/10/2000

Drawings, sheets:

1/1	as originally filed			
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2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

welded workpiece. No other indications in prior art are provided for solving the problem as proposed by the invention.

2. Claims 2-20 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step (Art. 33(2) and Art. 33(3) PCT).

3. The subject-matter of claim 21, understood as explained in item VIII is not new (Art. 33(2) PCT), see document DE-A-19814298, fig. 1, as this figure shows two workpieces with a visual transmissive material in one of the workpieces (column 2, line 15).

Re Item VII

Certain defects in the international application

1. Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

WELDING METHOD

The present invention relates to a method of forming
5 a weld between two workpieces, over a joint region.

Transmission laser welding is a technique which has
been developed for welding together materials such as
plastics. This is achieved by positioning two plastic
members in contact, one of which is transparent, the other
10 of which is opaque to visible light. The region of contact
between the two plastic members is then exposed to a laser
beam. The laser beam passes through the transparent
plastic member and is absorbed by the second opaque plastic
member. This causes the opaque plastic member to heat up
15 causing the region of contact between the two plastic
members to melt, thereby forming a weld. Examples are
described in "Laser-transmission welding of PE-HD",
Kunststoffe 87 (1997) 3, pp 348-350; Puetz H et al, "Laser
welding offers array of assembly advantages", Modern
20 Plastics International, September 1997; Haensch D et al,
"Joining hard and soft plastics with a diode laser",
Kunststoffe 88 (1998) 2, pp 210-212; and Jones I A,
"Transmission laser welding of plastics", Bulletin of The
Welding Institute, May/June 1998, and US-A-5893959.

25 All these methods are limited by the need to provide
at least one workpiece which is opaque to visible light.

In accordance with the present invention, we provide
a method of forming a weld between workpieces over a joint
region, the method comprising exposing the joint region to
30 incident radiation having a wavelength outside the visible
range so as to cause melting of the surface of one or both
workpieces at the joint region, and allowing the melted
material to cool thereby welding the workpieces together,
the method further comprising providing a radiation
35 absorbing material at the joint region in one of the
workpieces or between the workpieces which has an
absorption band matched to the wavelength of the incident

radiation so as to absorb the incident radiation and generate heat for the melting process, the radiation absorbing material being visually transmissive so that the material does not substantially affect the appearance of the joint region or the workpieces in visible light.

Accordingly, we provide a method for welding workpieces which can produce a visually transmissive weld. This is achieved by including visually transmissive material at the joint region which absorbs radiation outside the visible spectrum. The joint region is then exposed to radiation of this wavelength, causing the joint region to heat up. This in turn causes the workpieces to melt such that a weld is formed between the two workpieces. If the workpieces and the joint region are themselves transmissive to visible radiation, the weld is also at least translucent to the naked eye.

The workpieces may be opaque and have similar or dissimilar colours and/or be transparent or translucent to visible light.

In some cases, the material absorbent to the radiation is included in one of the workpieces.

In other cases, two workpieces may be welded together with the material being sandwiched between the two workpieces. This then enables workpieces which do not include a suitable radiation absorbing material to be welded together.

The radiation absorbing materials, which are typically in the form of additives, may comprise dyes or pigments while the use of an additive allows standard plastics and other materials to be readily modified to allow welding by the new method. Dyes are preferred to pigments because the particulate nature of pigments means that light scattering occurs and light absorption efficiency is reduced. In addition the low molar absorption coefficients of pigments means that higher concentrations have to be used to produce a given heating effect, and apart from the cost disadvantages, this can lead to undesirable changes in the

CLAIMS

1. A method of forming a weld between workpieces over a joint region, the method comprising:
 - 5 exposing the joint region to incident radiation having a wavelength outside the visible range so as to cause melting of the surface of one or both workpieces at the joint region, and allowing the melted material to cool thereby welding the workpieces together, the method further
 - 10 comprising providing a radiation absorbing material at the joint region in one of the workpieces or between the workpieces which has an absorption band matched to the wavelength of the incident radiation so as to absorb the incident radiation and generate heat for the melting
 - 15 process, the radiation absorbing material being visually transmissive so that the material does not substantially affect the appearance of the joint region or the workpieces in visible light.
2. A method according to claim 1, wherein the radiation
- 20 absorbing material is sandwiched between two workpieces.
3. A method according to claim 1, wherein the radiation absorbing material is provided in at least one of the workpieces.
4. A method according to claim 1, wherein the radiation
- 25 absorbing material is provided on the substrate by moulding the substrate in a mould with an insert formed by or including the radiation absorbent material.
5. A method according to claim 1, wherein the radiation absorbent material is provided as a coating on the
- 30 substrate.
6. A method according to claim 1, wherein the radiation absorbent material is provided by coextruding the material with the substrate.
7. A method according to any of the preceding claims,
- 35 wherein the radiation absorbing material is exposed to radiation prior to positioning the workpieces together.